



**Euro-FLOW: a European training and research network for environmental FLOW management in river basins.** A MARIE SKŁODOWSKA-CURIE ACTIONS Innovative Training Network (ITN) funded under H2020-MSCA-ITN-2017

**ESR 8: Testing the effect of hydrological alteration on stream ecosystem functioning**

**3 year fixed- term PhD position.**

**Host institute:** University of Birmingham, UK

**Supervisors:** Dr Mark Ledger and Prof Alexander Milner

**Project Description:**

Flow is recognized as a master variable that shapes the structure, functioning and service provision of freshwater ecosystems. The modification of natural flow regimes, through activities such as abstraction, irrigation and dam construction, can lead to major alterations in flow regimes, including in the frequency, intensity, duration and timing of high and low flows, with profound implications for stream biota. The science of environmental flows has evolved as means to manage and mitigate the worst impacts of hydrological change in rivers and streams, but the flow-ecology relationships that underpin water resource management are still poorly understood. This research project seeks to understand how modifications in flow regimes influences stream ecosystem functioning, and specifically explores whether ecological thresholds – the points at which small changes in environmental conditions lead to large shifts - exist in the nature of the relationship between flow and ecosystem functioning in streams.

Flow-ecology relationships can be challenging to quantify in natural systems, especially where the focus is on extreme events – floods and droughts – that are, by definition, rare and unpredictable. Experiments have been advocated recently as useful alternatives to surveys that are often confounded by long-term change in unrelated environmental conditions, and will be used here discern causal relationships among the many underlying stressors associated with hydrological alteration. The student will conduct mesocosm experiments in the University of Birmingham ECOLAB, a new £1.1M stream mesocosm research facility on campus. Here, flow can be manipulated in artificial streams located outdoors, and sensor networks can be deployed to sense change in ecological responses among biota (algal biofilms, invertebrates and fish).



**Figure 1: Mesocosm facility at UoB**

This project also benefits from being closely linked to research by other postgraduate and postdoctoral researchers investigating low flow impacts on stream ecosystems. The successful candidate will also gain from being part of a large, interdisciplinary, water research team based at the University of Birmingham.

**Objectives:**

- (1) Use artificial streams in the Birmingham ECOLAB facility to replicate elements of natural flow regimes, and simulate gradients of low and high flow versus control flow regimes
- (2) Determine the mechanistic basis of low flow impacts, via factorial manipulation of habitat connectivity, habitat/sediment area, temperature and water quality
- (3) Monitor impacts on water quality and ecosystem processes using sensor networks
- (4) Determine impacts on metabolism, algal production, and invertebrate-fish feeding links.

**Expected outcomes:**

- (1) Reveal how key ecosystem processes are impacted by flow modification
- (2) Identify tipping points and non-linear responses along gradients e.g. of low flow stress
- (3) Identify key environmental stressors that modify ecosystem processes when flows are modified, to form the basis of mitigation strategies
- (4) Evaluate the utility of mesocosms for e-flow science

**Secondments:**

Centre for Ecology and Hydrology, UK for 3 months, in year 2 or 3 to undertake community invertebrate analysis

University of Leeds, 3 months, in year 2 or 3 to learn and undertake food web data analysis